*Research Synopsis*

# GIS BASED DECISION SUPPORT SYSTEM FOR CROP SELECTION

*Submitted By*


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## 1. Introduction

Geographical Information System (GIS) is a computer-based technology which manipulates explains stores and analyzes information spatially and helps for planning and decision making by producing output in the form of maps and data tables. The present status of GIS and its potential trend of future development in the context of mainstream of IT must also be understood by examining the use of geospatial information in various sectors like Industrial sector, Business sector, Agriculture sector etc.

Spatial Data Mining (SDM) is a process of extracting general knowledge, laws and rules from the spatial database or Spatial Data Warehouse. The knowledge, laws and rules are implied in them, unclear in advance, potentially useful and spatial or non-spatial which ultimately easy to understand. The purpose of spatial data mining is that help people to improve the accuracy and reliability of the decision-making, and enable people to maximize the efficient use of data.

Today's great challenge in the field of agriculture in India is Precision Farming. In developed countries, farmers rely heavily on geographic information systems. But, in developing countries, the farmers still use predecessor's method for selecting crop for cultivation; they rarely consider the scientific facts which results in higher crop productivity. So in order to make the crop selection process scientific, it may be led by integrating GIS which will result in better crop productivity. GIS and SDM in the sector of Agriculture can be useful for making decision in the process of crop selection, yet very less study has been done for crop selection process using GIS and SDM and there is a lot of scope in this field to develop a decision support system by integrating GIS along with SDM techniques which would be beneficial for farmers in order to do precision farming. Geographic Information Systems (GIS) has existed for over four decades, the concept of which dates back to the 1960's when computers were used for spatial analysis and quantitative thematic mapping. GIS technology integrates common database operation such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by map. In GIS the geographical data are more important and geospatial data are corresponding to the location, near earth surface and

the geographical data are represented in the form of vector and raster. Vector data depict the geographical data in discreet point, Lines and polygon, whereas the raster data depict the geographical data in grid cell. The major challenges that we are facing in the world like over population, pollution, deforestation, natural disaster which have geographic dimension. Local problem also have geographic component that can be visualized using GIS technology. (1) Ensuring food security within a changing global climate together with the growing concern in reducing the environmental footprint of farming while increasing the economic viability of agricultural practices has resulted, in the last few decades, in the development of precision agriculture. Research and practice in precision agriculture aim at sustainably optimizing the management of agricultural fields by addressing the spatial variability in plant and environment. (2)

## 2. Literature Review

In (3) author has introduced the studies multi criteria spatial decision support systems (MC-SDSS) and describes the underlying technologies and theoretical background that are necessary to develop such system she also mention that multi criteria spatial decision support system (MCSDSS) provides a tool to combine and transform spatial and non-spatial data into a resultant decision. The author also had defined that main advantage of using DSS is facilitation of decision processes, DSS focus on effectiveness rather than efficiency in decision. Finally author had concluded that the fundamental techniques and approaches used in the design of multi criteria spatial decision support systems. It explains the basics of GIS and provides a framework for the integration of this technology into decision support systems. The paper summarizes the scope of the MC-SDSS and provides an introductory guide for the DSS designer

In (4) this paper the author has introduced Multi-Criteria decision-making method. The main purpose of the Multi-Criteria Evaluation (MCE) techniques is to investigate a number of alternatives in the light of multiple criteria and conflicting objectives. The result of this study has shown that the method used here was adequate to integrate climate, soil and relief database with different spatial and temporal resolutions in a GIS context. Using this method, thematic interpolated maps were generated, which has taken into account specific characteristics of crops, like growth cycle or phonological phases.

MCE of climate, soil and relief environment-components demonstrated to be useful to delineate suitable areas for maize and potato crops production. The author also conceded that the method applied here could be useful for the specialists of those countries with similar conditions to Mexico, as an alternative and reliable approach to delineate suitable areas for crops through the MCE technique in a GIS context.

In (5) the author had presented a MSHAF-based analysis program combining with agricultural multi-service collaborative technology for aiming at multi-sectorial, multi-platform spatial data, attribute data, structured data, unstructured data and other information resources to enable them to be grouped hierarchically according to their types and logical relations. The author also had introduced how to establish an efficient IT service system for the data acquisition, processing, transmission, storage, analysis and application of the GFPB site selection through the GPS and RS, which are also used as tools to obtain data, by using network-based information-transferring and -sharing channel, and by means of a set of new technologies including business flow, spatial and temporal analysis alike, which has innovatively broken through such problems as combining MSHDF and spatial analysis method based on GIS, achieved an agricultural decision support system of the capital GFPB site selection so as to provide sufficient evidence for the agriculture-related administrative departments to make decisions rapidly and reasonably. Finally the author concluded that the information resources like multi-sectorial and multi-platform spatial data, attribute data, structured data, unstructured data, etc., can be allowed to group hierarchically according to their types and logical relations, resulting in contributing appropriate specifications and feasible methods, achieving effective integration and fusion of cross-platform, cross-sector and multi-resource heterogeneous data sources, providing reliable asynchronous data transmission between different systems, supporting the integration of application systems in different regions also it is driving the GFPB site selection to convert from the traditional, extensive, experiential mode to the refined, collaborative and scientific comprehensive decision management mode and provides sufficient evidence for the agriculture-related administrative departments to make decisions rapidly and reasonably.

In (6) the author has introduced Land Suitability Evaluation Method Based on GIS Technology which had a purpose to serve the land use planning and kinds of land use decision-making new land suitability evaluation method emerged, and this method had a similar philosophy with the one based on GIS technology. Author also focused on Basic materials required for land suitability evaluation refer to survey and statistic information about nature, economic and social factors, which promote or restrict land use. Spatial scale and regional type determine the index system used to land suitability evaluation, and thus determine the contents of the basic information.

The result of this study has shown that for different types of spatial scales and regional property, the establishment of appropriate index systems and selection of indicators to divide evaluation units, are the assurance to obtain reliable evaluation results. The author also focused on GIS which play an important role in the whole process of evaluation, especially in the aspects of data collection, database creation, overlay calculation, spatial analysis and visualization.

In (7) author has introduced the GIS-based agriculture expert system which provide strong technology support for intelligent decision support system. The application of Expert System (ES) can provide the implementary scheme for the agricultural production. GIS can synthetically manage the various space-time data to provide the decision and the consultation services for the agriculture production. During his study author also had introduced the agriculture intelligence spatial decision support system can provide the networking, intelligent, and visual information service for producers and the technological managers in agriculture, provide the intelligence decision support for the precision fertilization and the scientific scheme for the precision management which is divided into 4 subsystem.

1. Agriculture soil geography information system: Which include Space database system, electronic map controlling subsystem, electronics map showing subsystem, electronics map exporting subsystem, searching and querying subsystem.

2. The agriculture soil variable-rate fertilization model system: The fertilization model adopts the target yield fertilization model, which studies the mathematic models for the nutrient absorptivity of crop unit yield, correcting system and the fertilizer utilization rate about different farming area of Hebei Province.

3. The agriculture soil fertilization expert system: The main function of this system is to provide the scientific implement project for the precision management.

4. The Soil fertilization intelligence decision support system of agriculture based GIS: The function of the subsystem is integration information of the space database, fertilization model database. The result of this study has shown that the GIS-based agriculture expert system is studied by combining network technology with ES and GIS technology together, which can provide the networking, intelligent and visual information and decision service for agriculture manufacturer and the decision-making support for the precision agriculture practice.

## 3. Research Outline

The research question, aims, objectives, significance, limitations and justification are defined in this section.

### 3.1. Research Question

The research question examined by this thesis is:

- How the GIS based Spatial Decision Support System (SDSS) and Spatial Data Mining (SDM) plays role in Crop Selection?

It hypothesized that a GIS based spatial decision support system as well as from the collected dataset a pattern can be extracted by applying various clustering algorithm to build a decision support system for crop selection.

### 3.2. Aim

The aim of this research is to develop GIS based Spatial Decision Support System for Crop Selection.

### 3.3. Objectives

The objectives of the study are as following:

- To develop the Thematic Cartography of Soil, Meteorology, Irrigation, Well Inventory, Road Network.
- To develop the model (Framework) for Spatial Decision Support System for Precision Farming and policy making.
- Validate the approach through an applied case study.

### 3.4. Significance

- The major contribution of this research can be summarized as:
- It gives factual decision support system to farmers for crop selection.
- Thematic maps help the non-experts in understanding the various complex factors.

## 4. Research Methodology:

The Development research approach is applied in response to answer the research problem. The flow of the procedure for proposed study is as depicted in figure 1, for the individual farm and in figure 2 for generalized.

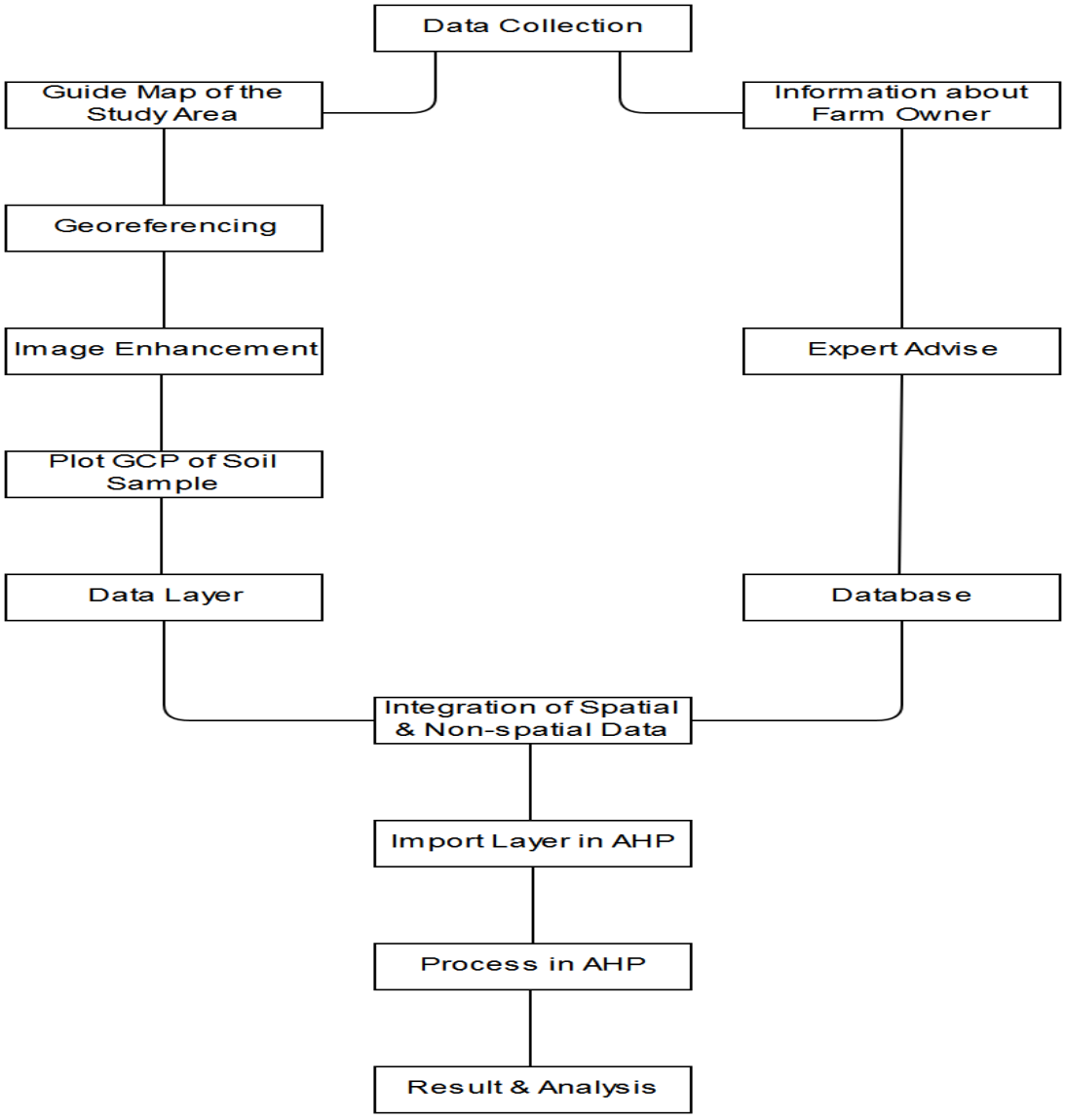


Fig. 1: Methodology for GIS Based Spatial Decision Support System for Crop Selection for Individual farm.

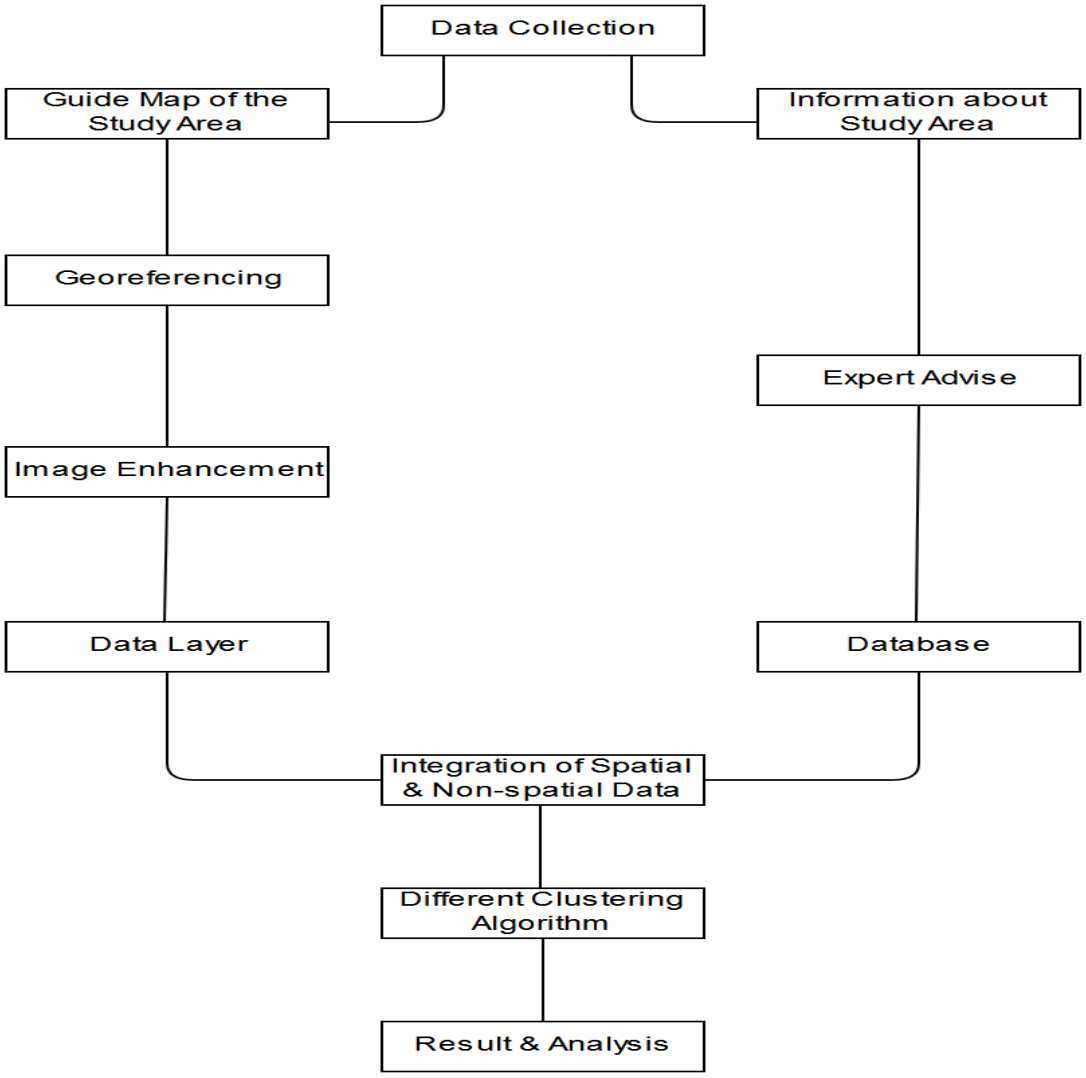


Fig. 2: Methodology for GIS Based Spatial Decision Support System for Crop Selection. (Generalized)

## 5. Expected Outcome

Focused on the methodology, this study aims to use Geographic Information System (GIS) and Spatial Data Mining (SDM) techniques to mine knowledge from various data and integrate agriculture's expert knowledge to analyze and predict the crop selection. The outcome from overall juncture lead to minor enhancements of the original theoretical outline and also provide new research question for future work.

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